Simplicity in Safety

Safety solutions from PHOENIX CONTACT

PHOENIX CONTACT
INSPIRING INNOVATIONS

Definitely the right decision!

Progressive technical development leads to ever faster and more complex production systems. Often, conventional safety solutions are no longer sufficient to protect the health of the operating personnel and to prevent damage to the production units. With this in mind, Phoenix Contact has developed future-oriented safety components and systems for various industrial functions and applications. Our easy-to-use solutions that have been developed in cooperation with numerous users and certifying bodies such as TÜV (German Technical Inspectorate) and BGIA (Professional Institute for Safety at Work) fulfill all relevant safety standards such as EN 954-1, EN ISO 13849-1, IEC 61508 and EN IEC 62061.

Our safety technology is characterized by the following features:

- Easy planning, installation, startup and maintenance
- High flexibility through modularity
- Top quality and reliability
- Comprehensive service

Effective cabling, safe installation
The PSR-SACB box conveniently connects up to four safety switches to one safety circuit and connects them to the safety relay using a cable. In addition, there are four alarm outputs available that can be evaluated in the controller.

Raiffeisen Fodder Plant, Kehl

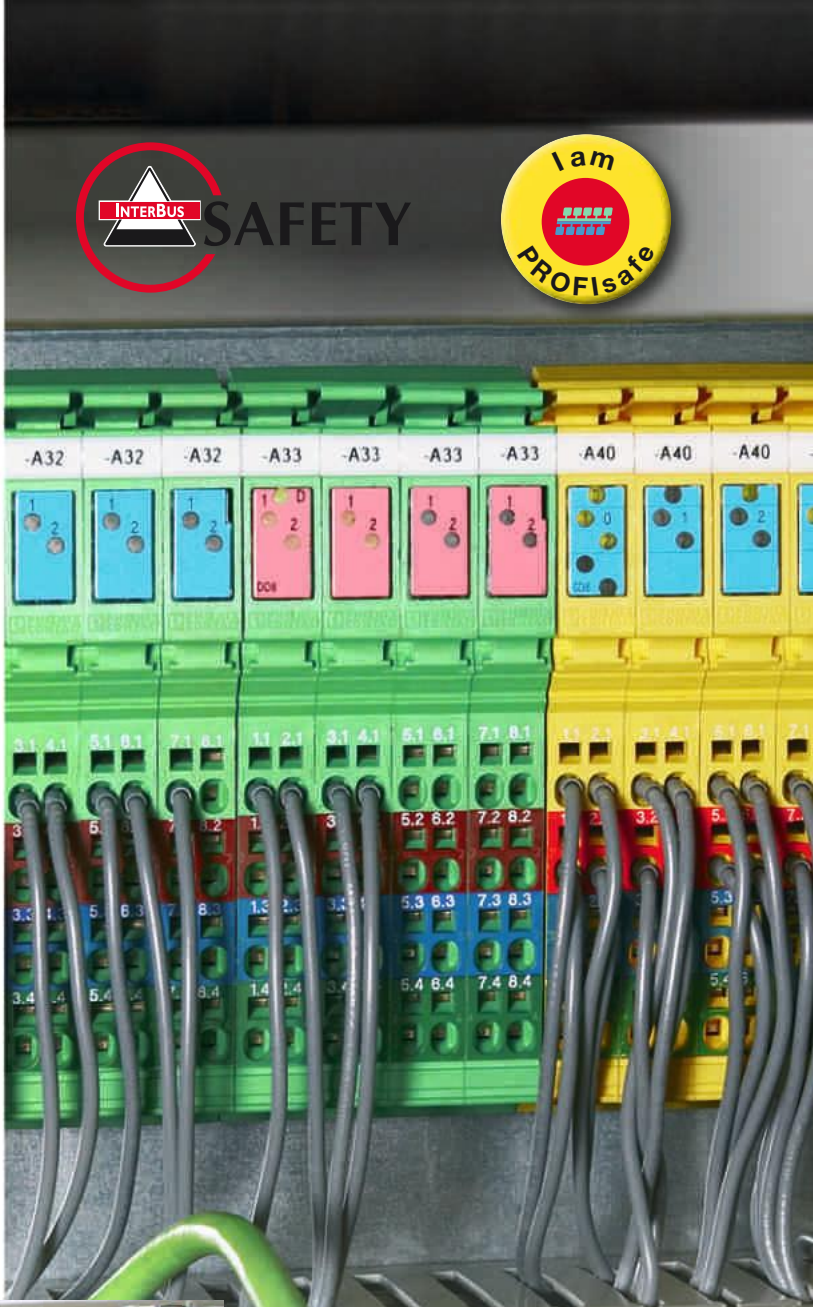
The pet food manufacturer has expanded the existing fieldbus solution in the grain mixing system with the Interbus Safety system. The changeover from conventional safety technology to Interbus Safety took just a weekend. Additional systems are to be retooled in the light of the fast conversion and lack of interruptions in the production process.

Audi AG

Audi AG uses Interbus Safety in the A6 body shop. The Interbus diagnostics with added safety functionalities provides high system availability. In addition to the fact that the response time has been reduced by half compared with conventional safety technology, this was another reason for opting for the safe bus system.

Safe system solution with Interbus Safety and Profisafe

The demand for cost-cutting applications and more flexibility is growing fast and that includes safety applications. With Interbus Safety and Profisafe, machine and system engineers have two systems dedicated toward these and other requirements. The main feature of the system is its simplicity: Easy integration into existing networks, easy to operate throughout the life cycle of the system, and easy adaptation to suit your changing application requirements. Further features of the systems are short startup times, high availability and maximum safety.



ThyssenKrupp Drauz Nothelfer GmbH
In a manufacturing cell in automobile manufacturing, Interbus Safety ensures high planning safety. A guaranteed switch-off time can thus be parameterized for each safe output channel.

Vocational school for metalworking and electrical engineering in Hanover
As part of a final examination project, Interbus Safety was added to a manufacturing system. The students couldn't believe how easy startup was: Read in the bus configuration – Link the process data – Connect the input and output variables with the safe modules – done!

Safe

Comprehensive PLCopen module libraries

As a manufacturer and product-independent association, the PLCopen specifies function modules for functional safety together with its members and its external certification centers. The PLCopen specification is an international software standard that covers the essential requirements of the user in the field of functional safety for applications. Phoenix Contact provides you with the function modules in the form of various libraries. Using them enables shorter startup times as well as a higher availability of the safety application.

The following basic applications are provided to the user as function modules certified in accordance with PLCopen:

- Emergency stop
- Safety door monitoring
- Feedback monitoring
- Reset block
- Electrosensitive protective equipment
- Enable switch
- Operating mode selector switch
- Safety door extension
- Two-hand control

Program components already created can be combined and declared as a single module to avoid repeated acceptance procedures for the same safety functions. It is then merely necessary to check the module wiring again.

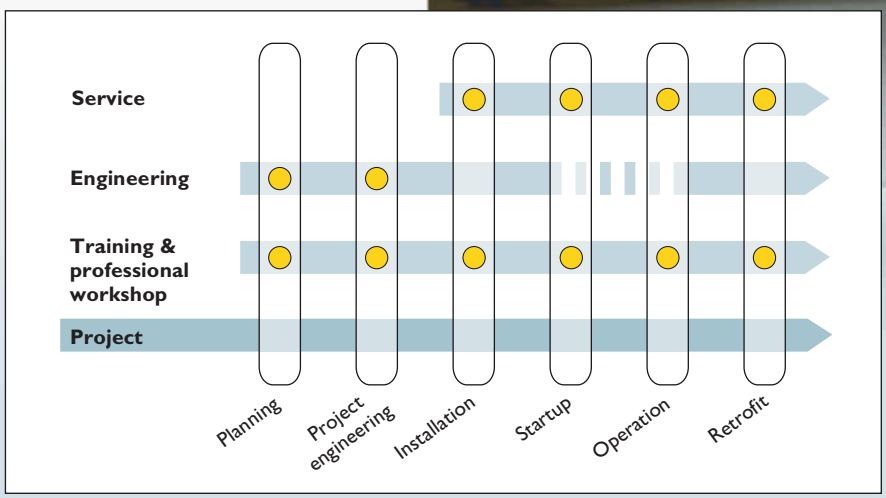
PLCopen safety

components and systems for e

Comprehensive range of services

Specific know-how is required to implement safe applications. In addition to adhering to all the relevant standards, the mechanical and plant engineer must also take into account the future application of the machine as well as the development of safety technology. This is why we support you right from the planning and programming stage, through startup and after-sales service, and throughout the entire life cycle of your safety application. Speak to our specialists and develop the technically and economically best possible solution with the versatility to adapt to new operating conditions and technologies.

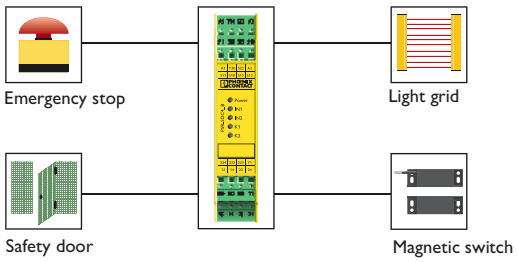
In addition to the standard services in the individual project phases, we also provide you with services in safety technology over the entire life cycle of your machine or system.



very application

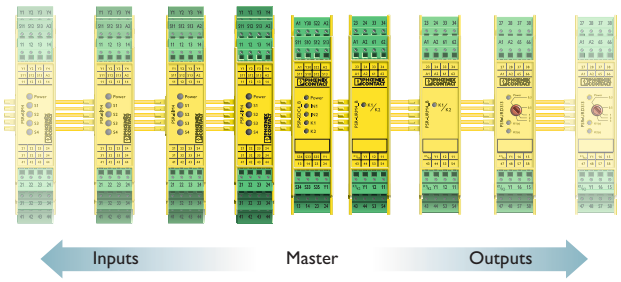
The advantages of the modular PSR safety relay system

Multi-functional and easy to configure



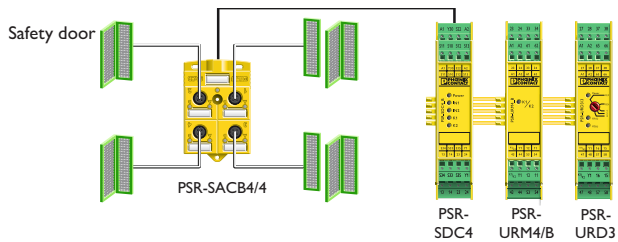
The multi-functional master module PSR-SDC4 is well-suited for emergency stop functions, safety doors, light grids and magnetic switches. The corresponding safety equipment is simply connected to the module. Programming or additional switch settings are not required.

Modular extension possible



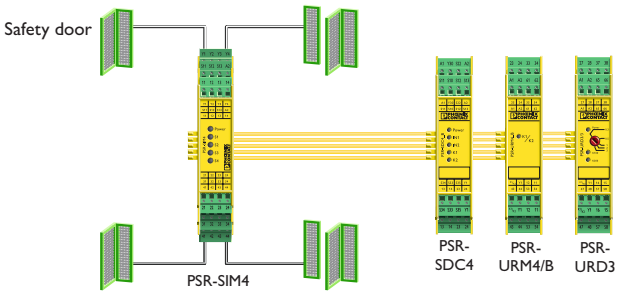
Additional extension modules can be connected easily for modular expansion to the PSR-SDC4 master module via the PSR-TBUS. Cross-wiring for further output contacts, for example, is not required.

Can be easily connected



Sensor box PSR-SACB4/4

Safety limit switches with N/O or N/C contacts can be directly linked together in the field by means of the PSR-SACB4/4 sensor box and connected to the PSR-SDC4 master module for evaluation.



Interface module PSR-SIM4

Safety limit switches can also be directly linked to the PSR-SIM4 interface module in the control cabinet. The PSR-SDC4 master module monitors the status of each connected safety switch.

The products of the modular PSR safety relay system

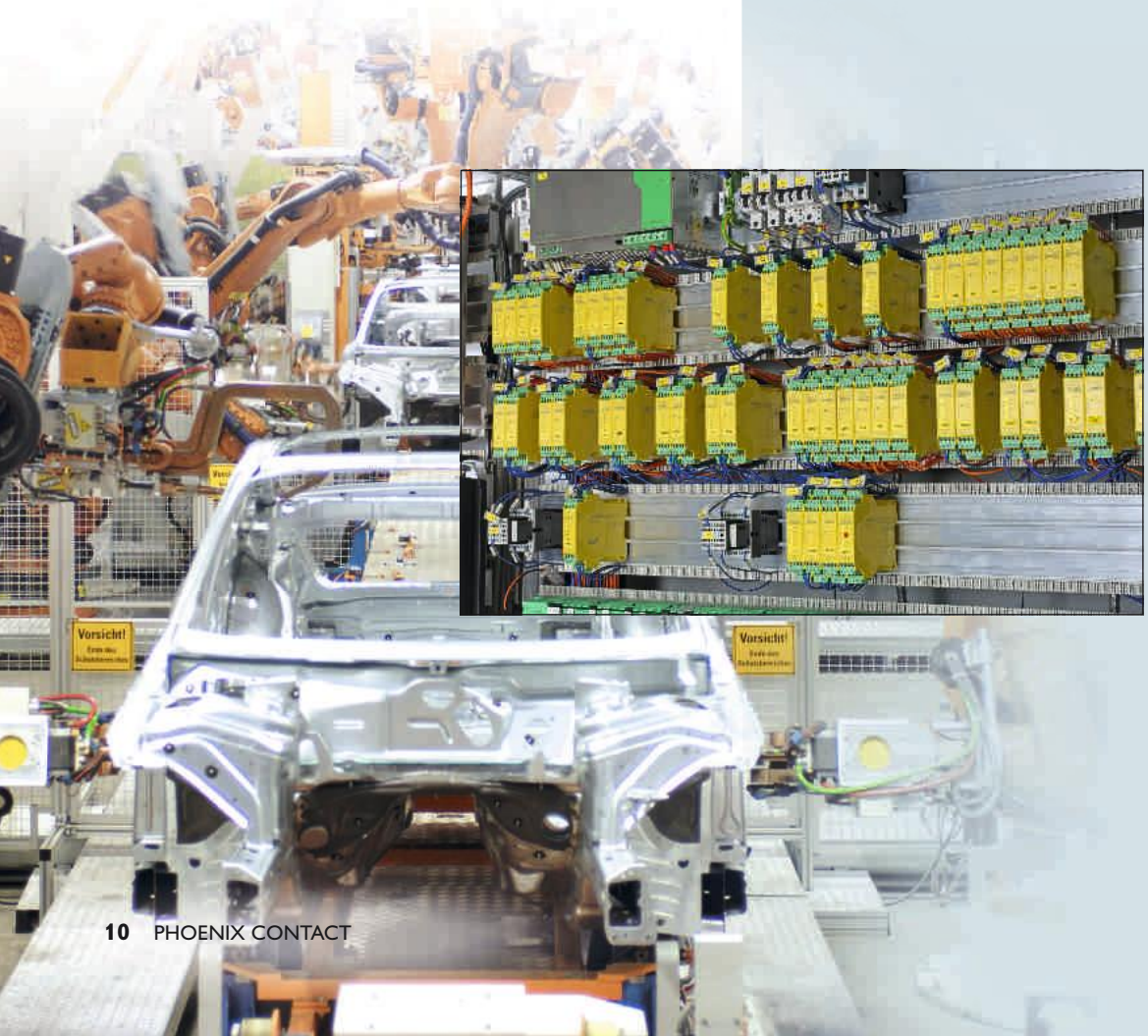
A number of safety applications, including emergency stop functions, protective doors or light grid monitoring, can be realized with just three different modules from the PSR safety relay system. The multi-functional PSR-SDC4 master takes over the evaluation of the respective safety sensor. Additional PSR-URM4/B and PSR-URD3 expansion modules with delayed and non-delayed contacts can be added via the DIN rail PSR-TBUS as required. As a result, the configuration and procurement costs, as well as the installation and warehousing costs, are considerably reduced.

PSR-SIM4

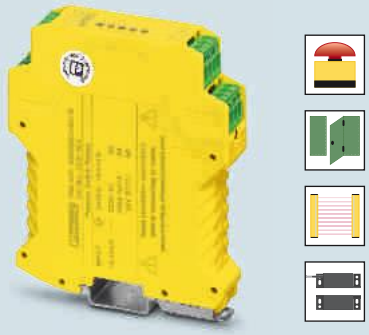
Order No. 2981936 (screw connection)

Order No. 2981949 (spring-cage connection)

- Interface module for the simple connection of up to four safety switches with one N/O or N/C contact each to a safety relay (e.g., PSR-SDC4)
- Modular extension possible so that, for example, eight or 12 safety switches can also be evaluated
- Max. safety category 3 in accordance with EN 954-1
- Four signal outputs



In the body shop production lines of the new Audi models A4 and A5, all safety technology is realized based on the modular PSR safety relay system. In the individual applications here, only three different modules are used: PSR-SDC4, PSR-URM4/B and PSR-URD3. Due to their compact design, the required control cabinet space was reduced by 50%.



PSR-SDC4

Order No. 2981486 (screw connection)

Order No. 2981499 (spring-cage connection)

- Safety relay master module for monitoring light grids, emergency stop, safety doors and magnetic switches
- Easy function selection without programming or additional switch setting
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Two enabling contacts and one signal output

PSR-URM4/B

Order No. 2981677 (screw connection)

Order No. 2981680 (spring-cage connection)

- Safety relay for contact extension (slave module)
- Max. safety category 4 in accordance with EN 954-1
- Four enabling contacts and one alarm and signal feedback contact each

PSR-URD3/3

Order No. 2981732 (screw connection)

Order No. 2981745 (spring-cage connection)

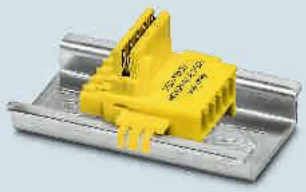
- Safety relay for contact extension (slave module) with adjustable delay time of 0.3 - 3 seconds
- Max. safety category 3 in accordance with EN 954-1
- Four delayed enabling contacts and one alarm and signal feedback contact each

PSR-SACB4/4

Order No. 2981871 (with 5 m cable)

Order No. 2981884 (with 10 m cable)

- Sensor box for the simple connection of up to four safety switches with one N/O or N/C contact each to a safety relay (e.g., PSR-SDC4)
- Max. safety category 3 in accordance with EN 954-1
- Four signal outputs
- Terminal plug available for unused slots (Order No. 1539570)



DIN rail connector

PSR-TBUS

Order No. 2890425

- DIN rail connector

PSR-TBUS-TP

Order No. 2981716

- Terminal plug, incl. bridge for the feedback circuit

Magnetically coded safety switches

Magnetic safety switches with N/O or N/C contacts are evaluated safely using a special input logic. Use of the PSR-SACB4/4 sensor box or PSR-SIM4 interface module is recommended if you are using several switches of this type. The safety switches can thus be easily interconnected as well as connected to the PSR-SDC4 safety relay without additional wiring.

Safety relays for emergency stop, safety door circuits and two-hand control systems

Easy and error-free installation of safety-related parts of the automation solution is indispensable in mechanical and plant engineering. In the control cabinet, different signals from the field must be monitored and evaluated for correct functioning and cross circuits. Our universally applicable PSR safety relays can be easily configured with the help of external wiring and make use of innovative connection technology. This reduces the project planning and installation time.

PSR-ESM4_B

Order No. 2963776 (screw connection)
Order No. 2963925 (spring-cage connection)

- Safety relay for emergency stop and safety door monitoring
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Manual and monitored activation
- Optionally with two or three enabling contacts and one alarm contact
- Optionally with or without safe isolation

In addition to the additional labeling option, the pluggable screw and spring-cage terminal blocks of the PSR safety relays are also coded in order to rule out the possibility of a mix-up of the terminals on a module.

PSR-ESA4_B

Order No. 2963763 (screw connection)

Order No. 2963941 (spring-cage connection)

- Safety relay for emergency stop and safety door monitoring
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Optionally with two or three enabling contacts and one alarm contact
- Optionally with or without safe isolation

PSR-ESA2_B

Order No. 2963802 (screw connection)

Order No. 2963954 (spring-cage connection)

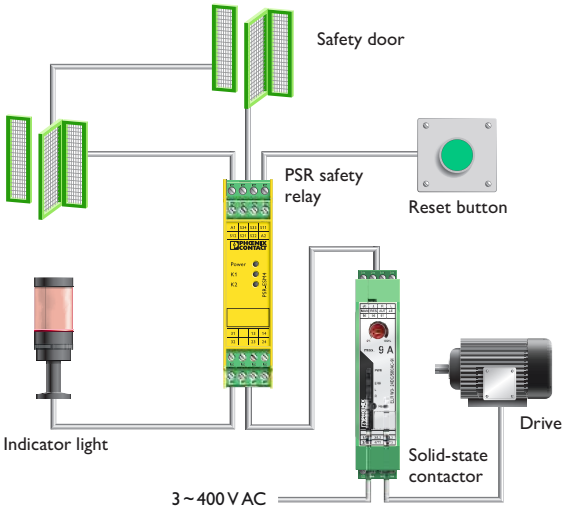
- Safety relay for emergency stop and safety door monitoring
- Max. safety category 2 in accordance with EN 954-1
- Single-channel control
- Manual or automatic activation
- Four enabling contacts and one alarm contact

PSR-THC4

Order No. 2963721 (screw connection)

Order No. 2963983 (spring-cage connection)

- Safety relay for two-hand control systems, and for safety door monitoring
- Max. safety category 4 in accordance with EN 954-1
- Two-channel control
- Automatic activation
- Two enabling contacts and one alarm contact
- Safe isolation between contacts



Example of a safety door application with a PSR-ESM4 safety relay that is activated manually using a switch. The drive is reliably switched off via a Contactron solid-state contactor.

Emergency stop/safety door

For monitoring the emergency stop and safety door circuits the PSR safety relays provide up to eight enabling current paths and one signaling current path. The modules with manual, monitored activation also check that the connected start button is functioning to guarantee reliable detection of errors.

Two-hand control systems

Two-hand control systems must be monitored for simultaneity of less than 0.5 seconds in accordance with the EN 574 standard. The time is checked and evaluated reliably by the corresponding modules in accordance with the category type III C.

Safety relay for use with light grids and safe time functions

In addition to monitoring the emergency stop and safety door circuits, the PSR-ESL4, PSR-ESAM4/8X1 and PSR-ESD-30 modules are also suitable for the evaluation of semiconductor outputs of light grids and laser scanners. The PSR-ESD modules have time functions with a dropout delay, and you can choose between a safety relay with a predefined delay time and a safety relay with an adjustable delay time.

The modules are protected against any subsequent manipulation of the setting elements by means of an adhesive label.

PSR-ESL4

Order No. 2981059 (screw connection)

Order No. 2981062 (spring-cage connection)

- Safety relay for light grid, emergency stop and safety door monitoring
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Three enabling contacts and one alarm contact

The ESL4 PSR safety relay provides three enabling contacts and one alarm contact for the evaluation of light grids up to cat. 4 in accordance with EN 954-1 in a 22.5 mm design.

PSR-ESAM4/8X1

Order No. 2963912 (screw connection)

Order No. 2963996 (spring-cage connection)

- Safety relay for light grids (types available on request), emergency stop and safety door monitoring
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Eight enabling contacts and one alarm contact
- Safe isolation between three contacts

PSR-ESD-30

Order No. 2981800 (screw connection)

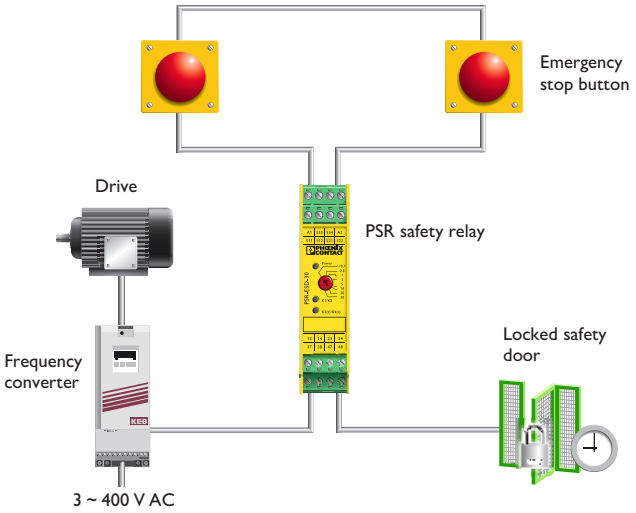
Order No. 2981813 (spring-cage connection)

- Safety relay for light grids, emergency stop and safety door monitoring with adjustable delay time of 0.1 - 30 seconds (0.2 - 300 seconds also available as an option)
- Max. safety category 3/4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Two undelayed and two dropout delayed enabling contacts

PSR-ESD-T

For order No., refer to the interface catalog 2007, page 25

- Safety relay for emergency stop and safety door monitoring; various module variants available for predefined delay times of 0.5 - 30 seconds
- Max. safety category 3/4 in accordance with EN 954-1
- Single or two-channel control
- Manual or automatic activation
- Three undelayed and two dropout delayed enabling contacts and one alarm contact



Example of a safety lock, in which the safety door can be opened only after the time (for shutting down the drive) set on the PSR-ESD-3 module has elapsed.

Safe time function

Applications such as locked protective covers or dynamic processes that require delayed contacts are connected accurately and reliably with the corresponding PSR safety relays up to cat. 3 in accordance with EN 954-1.

Light grids/laser scanners

OSSD (Output Signal Switching Device) semiconductor outputs of light grids and laser scanners ensure safe evaluation by the corresponding PSR safety relays.

Safety relays for process technology (SIL), shipbuilding (GL) and combustion plants (EN 50156)

The PSR-ESP4 safety relays that have been specially developed for safe semiconductor outputs are characterized by high reliability, low space requirement, simple wiring and optimized switch-on behavior. Conventional safety relays often have a very high inrush current, which control systems interpret as a short circuit. Thus, the PSR-ESP4, with its improved current consumption when switched on, is an ideal solution wherever safe electrical isolation of the control system from the application is required or the voltage or power is to be adjusted.

Pillard Feuerungen GmbH

Pillard Feuerungen GmbH is involved exclusively in furnaces for the cement, stone and earth industry, power engineering and environmental protection. Compact PSR safety relays that fulfill the requirements of the EN 60204 and EN 50156-1 standards ensure safe switching of the check valves in fuel lines. The fuel supply is thus reliably interrupted in the case of a fault.

PSR-ESP4

Order No. 2981020 (screw connection)

Order No. 2981017 (spring-cage connection)

- Safety relay for emergency stop and safety door monitoring and for safe electrical isolation from the control system and the peripherals
- Max. safety category 4 in accordance with EN 954-1 and SIL 3 in accordance with IEC 61508
- Single-channel control
- Manual or automatic activation
- Two enabling contacts and one alarm contact
- Safe isolation between contacts

PSR-ESAM4/3X1

Order No. 2981114 (screw connection)

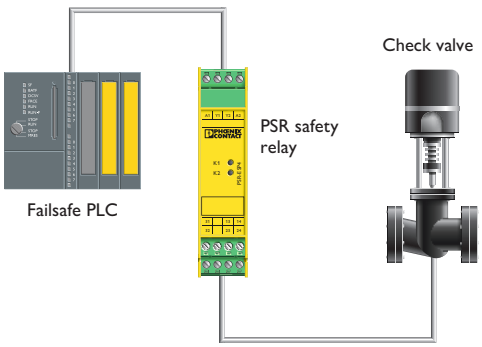
Order No. 2981127 (spring-cage connection)

- Safety relay for emergency stop and safety door monitoring
- Max. safety category 4 in accordance with EN 954-1 and SIL 3 in accordance with IEC 61508
- Single or two-channel control
- Manual or automatic activation
- Three enabling contacts and one alarm contact
- Safe isolation between contacts
- Wide-range input 24 V … 230 V AC/DC

Numerous approvals

Apart from the certification in acc. with IEC 61508 (SIL 3) that is important for process technology, the ESP4 PSR safety relay has the following additional approvals:

- Approval as per the regulations of the German Lloyd (GL), so that the relay can also be used in shipbuilding and in offshore systems
- Approval as per EN 50156-1 (safety level 3) that allows its use in combustion plants, steam generators, waste heat boilers, rotary furnaces and hot gas generators



Example of electrical isolation of a safety PLC output from the field using the ESP4 PSR safety relay.

IEC 61508 parts

As one of the first manufacturers, Phoenix Contact has provided a comprehensive portfolio of safety relays certified in accordance with IEC 61508 (SIL 3) which is being constantly expanded. The IEC 61508 standard relevant for process technology is based on four main pillars that help reduce the residual risk:

- A complete documentation describing all product life cycle phases
- The special requirements for the QM system to avoid errors
- Determining and calculating safety-related reliability specifications, which are used to determine the time of a functional test
- The requirements regarding diagnostic measures to be implemented for detecting and rectifying the errors that could possibly occur.

Safety relays for contact extension and universal use

The PSR-URM4 relays, which, like all PSR safety relays, incorporate positively driven contacts in accordance with EN 50205, are suitable for the duplication of contacts. Up to five N/O contacts and two N/C contacts have been integrated into the housing with a width of just 22.5 mm. These contacts are mechanically interconnected and are therefore always arranged in the same position due to the fully positively-driven operation. Welding of an N/O contact, for instance, can thus be signaled in the case of an error. The corresponding base module evaluates the state and reliably prevents a restart of the safety function when it is demanded.

PSR-URM4_B

Order No. 2981033 (screw connection)
Order No. 2981046 (spring-cage connection)

- Safety relay for extending the number of contacts
- Max. safety category 4 in accordance with EN 954-1
- Single or two-channel control
- Five enabling contacts and one alarm and readback contact each
- With or without safe isolation

Kirchenwald tunnel, Switzerland

Connecting gates between the two tubes of the Kirchenwald tunnel serve as a way of escape from the other tube in the case of an emergency. Special safety strips were used in order to avoid the danger of being crushed when the gates are activated. These safety strips comprise PSR safety relays to extend the number of contacts of the evaluating devices used.

PSR-URM

Order No. 2963747 (screw connection)

Order No. 2963970 (spring-cage connection)

- Positively driven coupling relay
- With a choice of five N/O and two N/C contacts, or with three N/O and three N/C contacts
- Available for 24 V AC/DC and 120 V AC/DC

PSR-URM/2X21

Order No. 2981363 (screw connection)

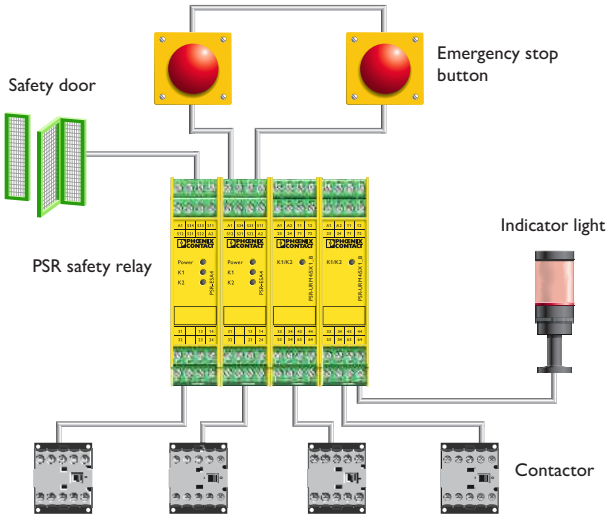
- Positively driven coupling relay
- Two PDT contacts
- Available for 24 V AC/DC and 120 V AC/DC
- Narrow housing width with only 17.5 mm width
- Permanently soldered-in relay

PSR-URM/4X1

Order No. 2981444 (screw connection)

Order No. 2981457 (spring-cage connection)

- Positively driven coupling relay
- Four N/O and two N/C contacts
- Available for 24 V AC/DC and 120 V AC/DC
- Permanently soldered-in relay



Example of an emergency stop/safety door application with ESA4 PSR safety relay that is supplemented with URM4_B contact extension modules.

Extending the number of contacts

Often, more contacts are required than those that are normally available. The positively driven contact extension modules can be used in such applications. Depending on the requirement, they can be connected as modules.

Positively driven coupling relays

Like all PSR switching devices, the coupling relays for universal use also have positively driven contacts in accordance with the EN 50205 standard. They can be used in all safety-related applications due to the fully positively driven N/C and N/O contacts.

Safety relays for downtime and speed monitoring

If, for instance, the safety door is open when setting up a machine or when working in special operation mode, the drive speeds must be monitored reliably. Unlike other, often complex solutions, monitored speed can be easily set in the PSR-RSM4 safety relay using a software. The relay records the speeds either using standard sensors or an incremental encoder that has been connected to the monitoring module with an RJ45 cable adapter. If the set speed is exceeded, the RSM4 module switches off the machine safely using redundant N/O contacts.

The speed monitoring module is configured via the serial interface using a Windows-based, easy-to-operate software.

n=0

SIL
IEC 61508

PSR-SSM

Order No. 2981567 (screw connection)

Order No. 2981570 (spring-cage connection)

- Safety relay for downtime monitoring
- Max. safety category 4 in accordance with EN 954-1 and SIL 3 in accordance with IEC 61508
- Two-channel control
- Automatic activation
- Two enabling contacts and two alarm contacts

n=0

n

SIL
IEC 61508

PSR-RSM4

Order No. 2981538 (screw connection)

Order No. 2981541 (spring-cage connection)

- Safety relay for monitoring up to three different speeds during operation and monitoring of downtime
- Max. safety category 4 in accordance with EN 954-1 and SIL 3 in accordance with IEC 61508
- Two-channel control
- Manual or automatic activation
- Two enabling contacts each for overspeed and downtime and three signal outputs
- Easily configurable using the PSR-CONF-WIN software

PSR-CONF-WIN1.0

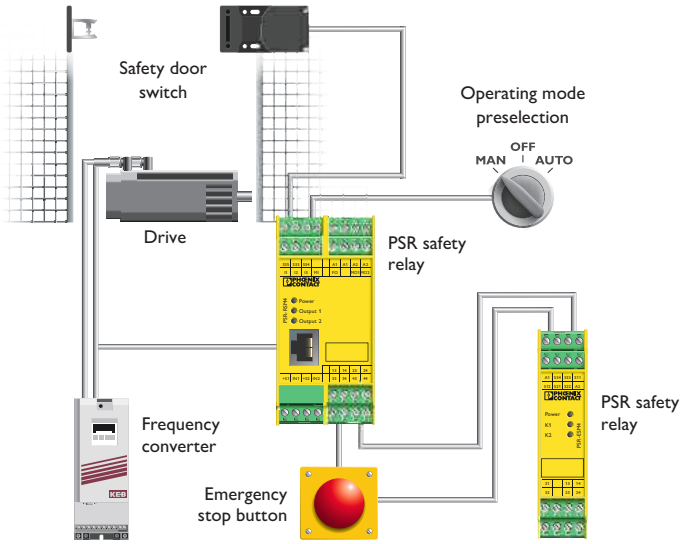
Order No. 2981554

- Configuration software with connecting cable for PSR-RSM4

CABLE-:../8/250/RSM/…

For order no., refer to the Interface catalog 2007, page 28

- Cable adapter for PSR-RSM4
- Cable length 2.5 m
- For Siemens, Indramat, AMK, Heidenhain and Aradex control systems (more types available on request)



Example of speed monitoring of a drive using the engine-side incremental encoder. An emergency stop is triggered if the speed is exceeded when the safety door is open.

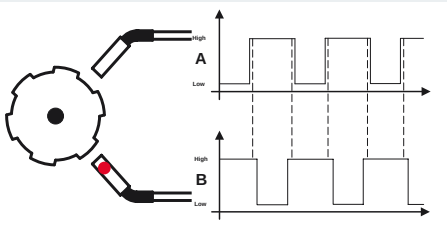
n=0

n

Downtime and speed monitoring

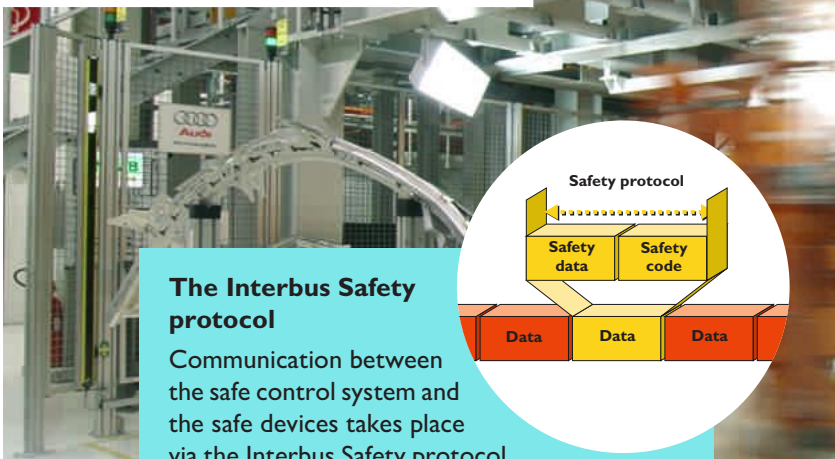
The PSR-SSM downtime monitor monitors the downtime of a gearwheel or a gear rack. It is controlled by two standard initiators and additionally monitors cable or wire break.

The PSR-RSM4 speed monitor is used for speed monitoring in automatic, special and set-up modes and during downtime. The module is controlled using two proximity switches or an incremental encoder.



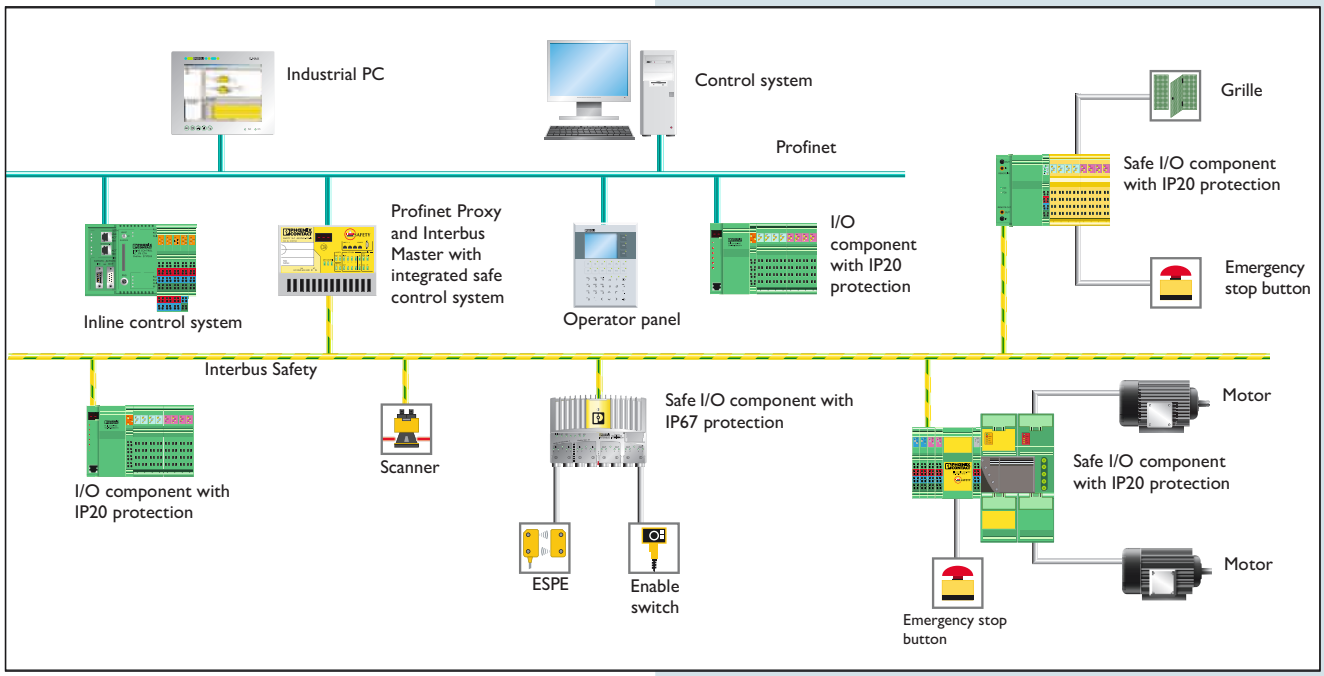
Interbus Safety – Maximum safety based on a simple functional principle

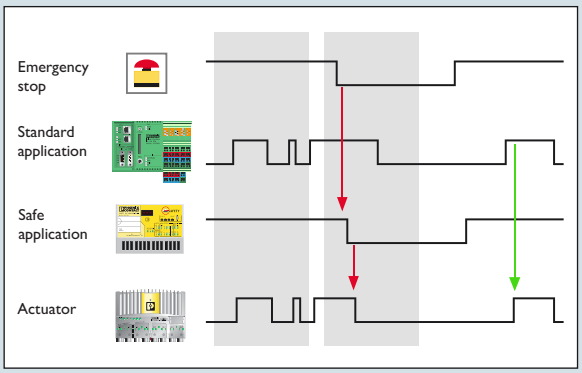
The safe control unit functions as an accept unit in the Interbus Safety system, i.e. it accepts the application output of the standard control system. Thus, you can create the standard application in the usual manner, program the safety technology separately and get it accepted. We provide function modules that have been certified in accordance with PLCopen for standard applications such as emergency stop or safety door monitoring. Not only do the modules minimize programming, but they also increase the clarity of the solution.



The Interbus Safety protocol

Communication between the safe control system and the safe devices takes place via the Interbus Safety protocol. The safe protocol data is integrated into the data flow of the standard Interbus system just like normal device data. The integrated safety protocol can be evaluated only by the safe components.





If the emergency stop button is pressed, the safe control system switches off the output using the safe output module. The safe control system accepts the setting of the output through the standard control system only when all input conditions have been fulfilled again.

Interbus Safety convinces with its outstanding features:

Convenient integration

Interbus Safety can be retrofitted easily in existing automation solutions. Here, the standard control system is replaced by a Profinet Proxy and Interbus master with an integrated safe control system. Depending on the requirement, the user can now operate safe and standard devices on one bus line or separate them using a two-cable solution.

Easy operation

Besides retaining the usual method of operation of the standard Interbus system, the one-bit principle also contributes to easy handling of Interbus Safety. The safe module electronics generate a safe bit from the safe peripheral signals. The programmer processes the safe bit in the safe programming software SafetyProg by linking it to modules.

Precise diagnostics

The diagnostics functions of the standard Interbus system have been transferred to Interbus Safety so that the user on site knows which safety function has been triggered and why. While the LEDs on the components display I/O or bus errors, comprehensive diagnostics information is automatically shown in plain text on the controller and via the diagnostics software Diag+.

Short response times

Since the Interbus system permits very short cycle times of 2 to 5 ms due to the transfer procedure, the process can be switched off safely within a very short time. The response times can be calculated in detail, since the Interbus protocol is deterministic in structure. Usually, there are no fluctuations in the cycle time.

Guaranteed switch-off time

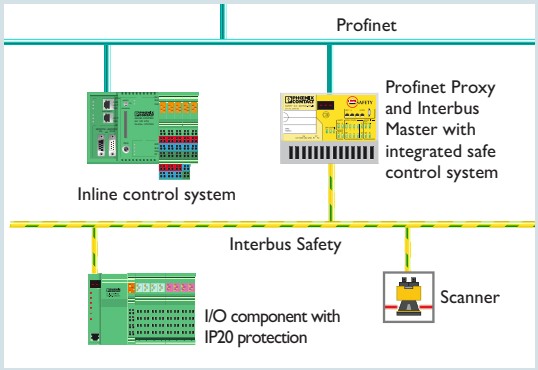
Interbus Safety is the only safe bus system that is currently able to monitor the response time over the entire safety chain channel by channel and to switch off the corresponding output in the case of limit overshoot. The switch-off time to be monitored is simply parameterized and guaranteed over the entire safety chain.

Maximum safety

Internal time switches, failsafe comparators, pulsed outputs, cycle-sensitive inputs and the safety protocol ensure that the probability of errors is minimal and lies within the limits defined for SIL 3/IEC 61508 and cat. 4/EN 954-1. Current standards such as EN ISO 13849-1 and EN IEC 62061 are also taken into account.

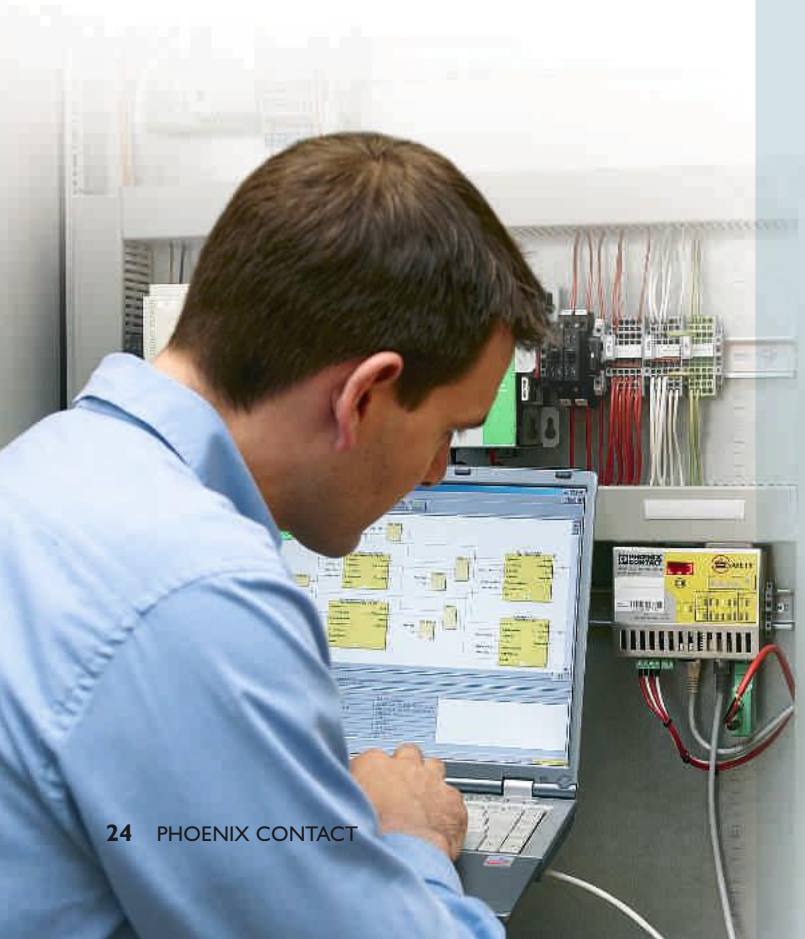
Interbus Safety – High-performance control technology

Because it is integrated into the PC Worx automation software, the Interbus Safety system can be operated using the corresponding control systems of our comprehensive portfolio. The Profinet Proxy and Interbus Master with an integrated safe control system, for instance, acts as a link between the safe and the standard applications. The safe and the standard components are integrated uniformly into the turn-key solution by universal engineering. Easy project planning of the system, uniform diagnostics and intuitive programming using PC Worx and SafetyProg simplify the handling and the time required for setup.



Easy integration into Profinet networks

The Profinet proxy and Interbus master with an integrated safe control system has an Interbus master and a Profinet slave. The safe control system accesses the Interbus Safety system via the module in order to read in the safe inputs, to process the safe output program and to control the safe outputs. The safe application is programmed with the SafetyProg software.



The SLC 400 PND-4TX-IB can be integrated as a client into any Profinet network as a control-system-independent safety control system.

Safety SLC 400 PND-4TX-IB

Order No. 2985563

- Profinet Proxy and Interbus Master with integrated safe control system
- Max. 126 safe input and output modules
- Pluggable CF-Flash parameterization memory
- 10/100BASE-T Ethernet connection, RJ45, 4 port switch
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

System packets

ILC 350 PN IB-SAFETY KIT
Order No. 2916451

ILC 370 PN IB-SAFETY KIT
Order No. 2916561

ILC 390 PN IB SAFETY KIT
Order No. 2916671

Consists of the Safety SLC 400 PND-4TX-IB module, the ILC 350, 370 or 390 PN control system and an Ethernet cable

IBS S7 400 ETH SDSC

Order No. 2819558

- Interbus Safety controller board with integrated safe control system
- Max. 126 safe input and output modules
- Pluggable CF-Flash parameterization memory
- 10/100BASE-T Ethernet connection, RJ45, single port
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

System packets

IBS S7 400 ETH SDSC SYSKIT
Order No. 2737575 (German)

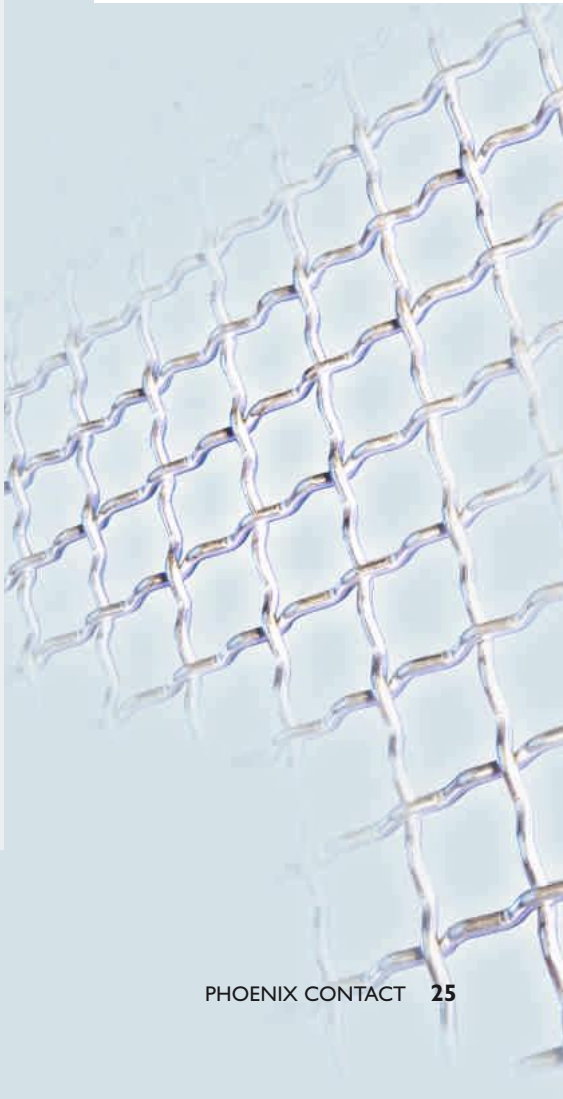
IBS S7 400 ETH SDSC SYSKIT E
Order No. 2737407 (English)

Consists of the IBS S7 400 ETH SDSC module, the SAFETYPROG 2 PRO software packet, a programming cable, a parameterization memory and the safety system documentation in German or English

Integrated safety control system

The high performance of the safety control system and its synchronization with reference to Interbus cycles contribute a great deal to the fast response time of the entire system and allow it to be monitored at all. The following features affect the performance positively:

- Runtime of the safe function modules within milliseconds
- Clear separation of the safe control system from the standard control system to rule out mutual interference
- Two-channel parallel execution of the safety program
- Synchronization with the Interbus cycles in order to avoid loss of time through scanning
- No additional load due to device or channel drivers, since signal diagnostics takes place on the components



Interbus Safety – Safe I/O modules for the control cabinet and the field

The inputs and the outputs of the safe I/O modules with IP20 and IP67 protection, which have been integrated in the application are parameterized according to the application. Here, you can opt for single or two-channel signals, two test cycles, diagnostics for short and cross circuit, an equivalent or antivalent signal image and currents up to 2 A for the outputs. In this manner, all the single or two-channel standard sensors and actuators can be integrated into the safe fieldbus system. The safe segment disabling is used to switch off the following output components safely. In combination with the safe Inline module IB IL 400 SAFE 2, 400 V circuits can also be switched off safely.

IBS RL 24 SDIO 4/4/8-LK

Order No. 2737520

- Rugged Line safety module with IP67 protection
- Four safety-oriented two-channel inputs and outputs each or eight safety-oriented single-channel inputs and outputs each
- Two pulsed outputs for supply to the UT1 and UT2 inputs
- Max. 2 A per output (observe the derating)
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

Our safe I/O modules can be used in all standard safety applications such as the emergency stop equipment, light curtains and scanner applications as well as in safety circuits for the safe switching of contactors, motors, valves and ohmic and inductive loads.

IB IL 24 SDI 8-PAC

Order No. 2985657

- Inline safety terminal with IP20 protection
- Four safety-oriented two-channel inputs each, or eight safety-oriented single-channel inputs each
- Two pulsed outputs for supply to the UT1 and UT2 inputs
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL 24 SDO 8-PAC

Order No. 2985754

- Inline safety terminal with IP20 protection
- Four safety-oriented two-channel outputs each or eight safety-oriented single-channel outputs each
- Max. 2 A (observe the derating)
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL 24 SDOR 4-PAC

Order No. 2985851

- Inline safety terminal with IP20 protection
- Two safety-oriented two-channel relays or four safety-oriented single-channel relays (two floating contacts each)
- Two readback inputs for recording external circuit breakers and two pulsed outputs to the readback inputs
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL 24 SDIO 4/4/1

Order No. 2863740

- Inline safety terminal with IP20 protection
- Four safety-oriented two-channel inputs and outputs each or eight safety-oriented single-channel inputs and outputs each
- Two pulsed outputs for supply to the UT1 and UT2 inputs
- Max. 2 A per output (observe the derating)
- One safety-oriented segment circuit output, max. 6 A
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL 24 SAFE1-PAC

Order No. 2861564

- Inline safety terminal with IP20 protection
- Two safety-oriented inputs for direct connection of emergency stop, safety door and switching mat
- One safety-oriented segment circuit output, max. 4 A
- Max. safety category 4 in accordance with EN 954-1

IB IL 400 SAFE 2

Order No. 2740795

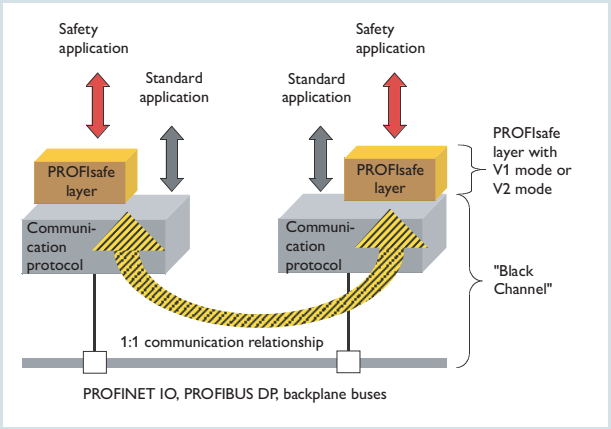
- Inline safety terminal with IP20 protection
- Three N/O outputs, max. 12 A/600 V AC, 5500 VA
- Three N/O relay outputs, max. 12 A/600 V AC, max. 5500 VA
- Max. safety category 4 in accordance with EN 954-1

Profisafe – Safe I/O modules for the control cabinet

Depending on the bus coupler used, the Profisafe modules of the Inline installation system can be operated on Profibus-DP and Profinet solutions so that these networks, too, profit from the advantages of the safe Inline modules. Within the Profisafe system, safety functions with the following requirements can be realized this way:

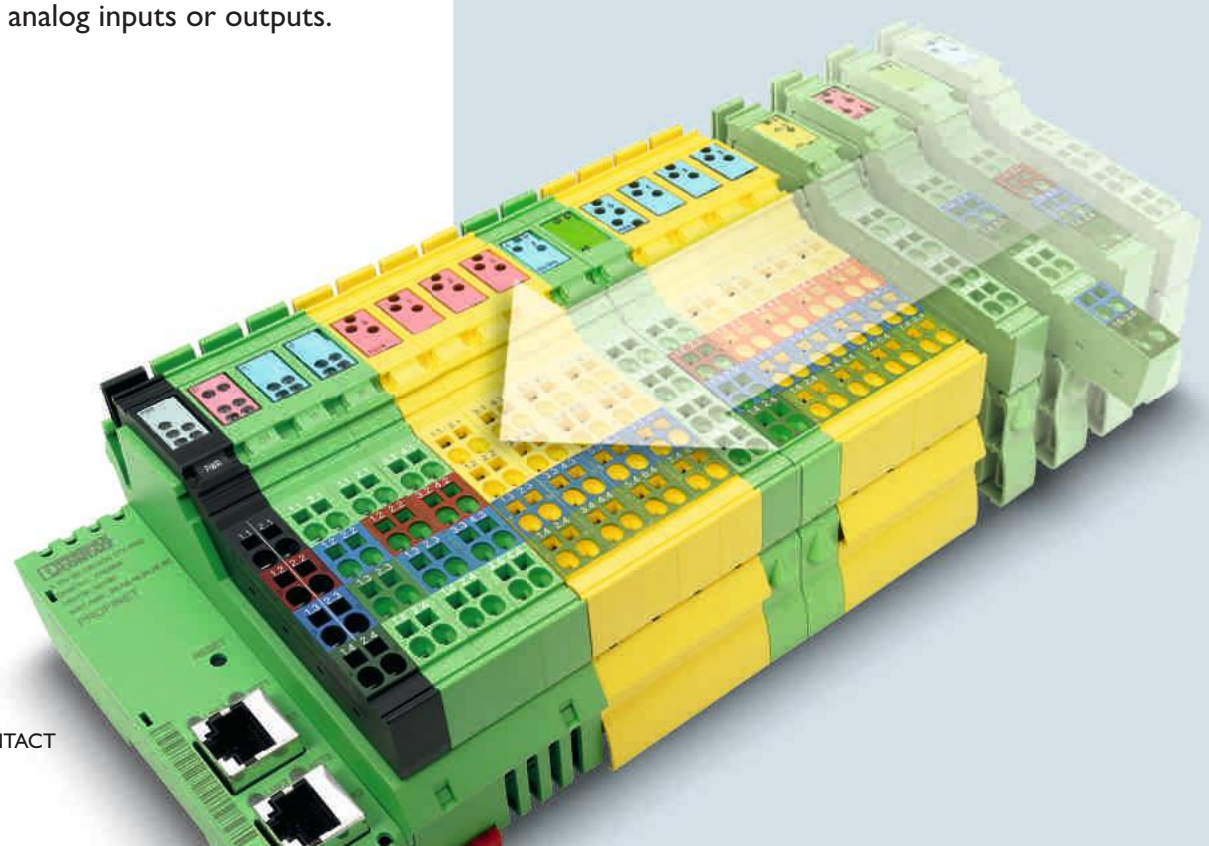
- Up to category 4 according to EN 954-1
- Up to SIL 3 in accordance with EN 61508 and EN IEC 62061
- Up to PL e in accordance with EN ISO 13849-1.

An Inline station can be made up of safe and standard modules here, whereby a variety of function terminals are available to the user. The station is configured with fine granularity with digital and analog inputs or outputs.



Black channel mechanism

In order to be able to transmit safe and standard data via a bus cable, the Profisafe protocol is exchanged between the safe control system and the safe I/O components via a "black channel". Here, the safety telegrams with their independent safety mechanisms are embedded in a standard telegram of the Profinet system and are only unpacked in the respective safety terminal.



IB IL 24 PSDI 8-PAC

Order No. 2985688

- Inline safety terminal with IP20 protection
- Four safety-oriented two-channel inputs each, or eight safety-oriented single-channel inputs each
- Two pulsed outputs for supply to the UT1 and UT2 inputs
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL 24 PSDO 8-PAC

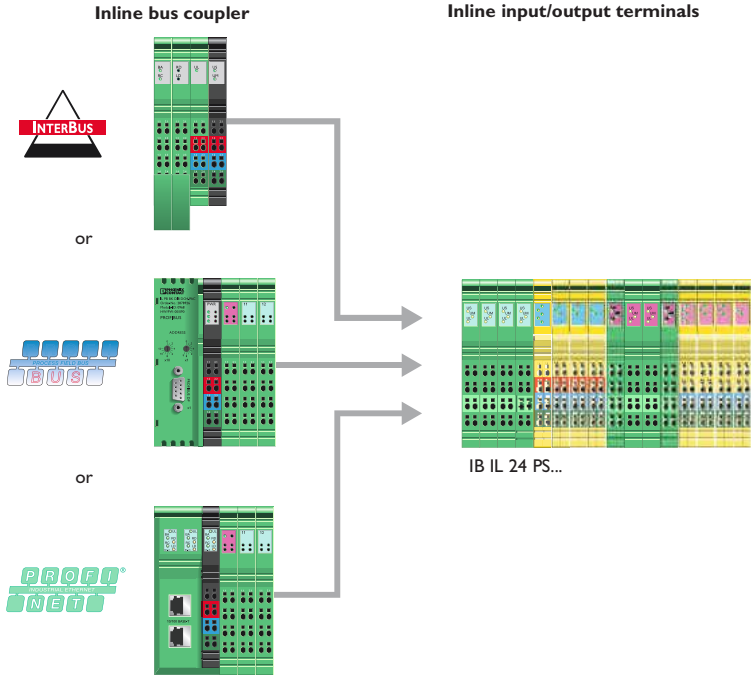
Order No. 2985631

- Inline safety terminal with IP20 protection
- Four safety-oriented two-channel outputs each or eight safety-oriented single-channel outputs each
- Max. 2 A per output (observe the derating)
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)

IB IL PSDOR 4-PAC

Order No. 2985864

- Inline safety terminal with IP20 protection
- Two safety-oriented two-channel relays or four safety-oriented single-channel relays (two floating contacts each)
- Two readback inputs for recording external circuit breakers and two pulsed outputs to the readback inputs
- Max. safety category 4 in accordance with EN 954-1, PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with IEC 61508 (EN IEC 62061)



Easy integration

The safe Profisafe modules can be integrated anywhere on the Inline station, whereby mixed operation of standard and safety terminals is possible. The safe control system in the Profinet or Profibus network is connected with an appropriate bus coupler. In addition to the Profisafe functions, the modules can also be used in the Interbus safety systems via the address switches.

Sensors and actuators are conveniently integrated in the respective safe bus system via the inputs and outputs of the Profisafe modules. The settings can be parameterized flexibly for single or two-channel I/O wiring as well as for diagnostics.

Interbus Safety – Easy programming of safety networks

The faster the project planning, programming and startup and the more detailed the display of the diagnostics information, the higher the machine or system availability. For this reason, we have developed a software solution with SafetyProg that will support you with a large number of user-friendly functions, easy handling and clear structuring when installing your safe application. The safe interface is supplemented with the software tools of AUTOMATIONWORX Software Suite.

SAFETYPROG 2 PROG

Order No. 2985835

- Programming software for Interbus Safety systems
- Graphical interface in accordance with IEC 61131-3 in the languages ladder diagram (LD) and function block diagram(FBD)
- Including the configuration software Config+ and diagnostics software Diag+
- Including the software libraries SafetyProg 2.x Basic (basic functions of the Interbus Safety system) and SafetyProg2.x system (diagnostics and handling of the Interbus Safety system)

Easy handling of SafetyProg thanks to the fact that:

- The safe program is created independently of the external wiring
- Certified modules are available for many safety functions
- Safety categories can be changed later by re-configuring the peripheral components
- Complete processes can be pre-tested by means of simulation of devices
- Programming errors are displayed in plain text

AUTOMATIONWORX Software Suite

Order No. 2985660
(contains demo versions for registration)

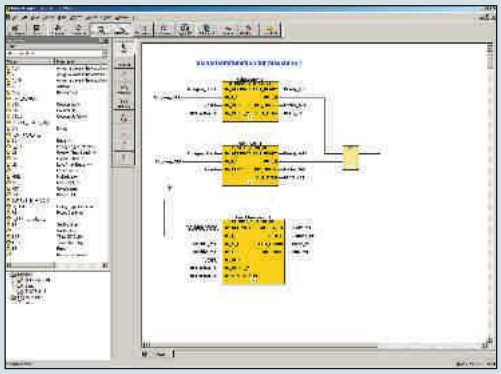
The Suite comprises the following software tools:
- PC Worx for project planning, programming and diagnostics of Interbus, Ethernet, and Profinet-IO networks
- Config+ for project planning and diagnostics of Interbus, Ethernet, and Profinet-IO networks
- Diag+ for diagnostics of Interbus, Ethernet and Profinet-IO networks
- Diag+ NetScan for network diagnostics and monitoring of several control systems
- Visu+ as a visualization system including OPC server
- WebVisit for visualization via the web server
- AX+ Basic for device parameterization through FDT
- Other tools and function block libraries

CD AX SOFTWARE LIB

Order No. 2819749

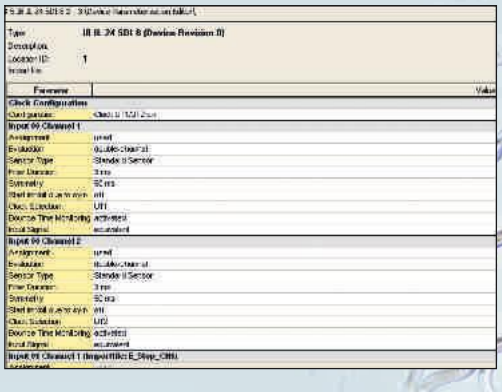
The CD-ROM comprises the following software products:
- Certified function modules (see below) to make programming and the prevention of errors easier
- Example programs
- Driver
- Software tools

The function modules required for the basic operation of AUTOMATIONWORX are available as freeware. Software functions as universal part applications or the engineering tools must be purchased. In order to preview their scope of functionality, the functions can be loaded without a license key. The appropriate key must be obtained for installation.



Clear structure

All necessary information is displayed structured and separately using the multiple window principle. In addition, the relevant documentation can be called up for every peripheral component.



Easy device connection

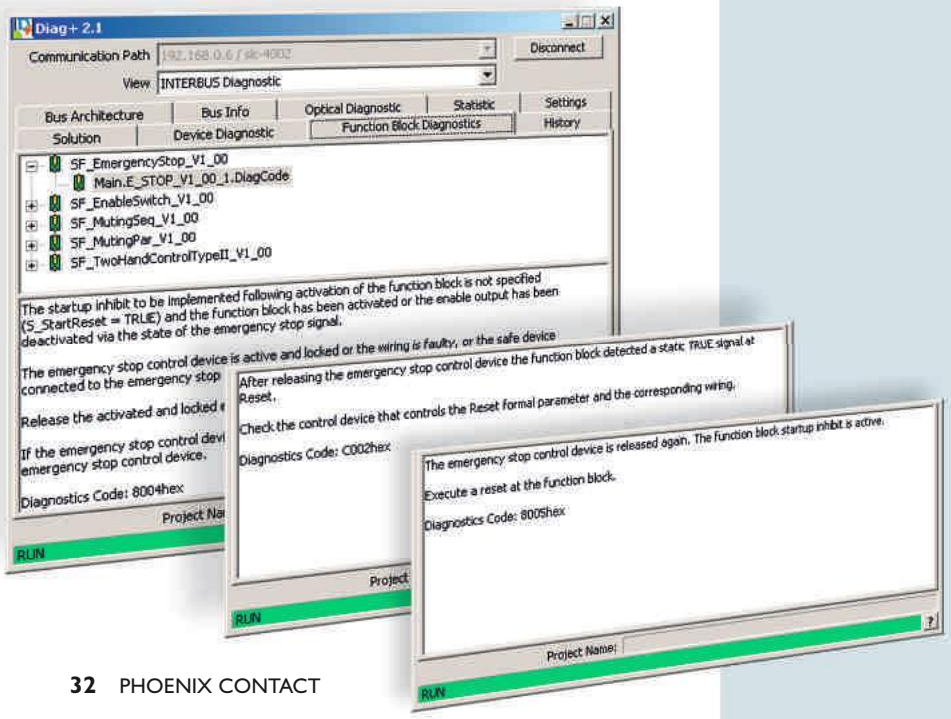
The numerous parameterization settings make it possible to connect all common sensors and actuators to the Interbus Safety components. The settings can also be imported if you want to simplify the process. They are displayed in gray on the interface and cannot be modified.

Interbus Safety – Safe PLCopen function modules for SafetyProg

Using the PLCopen function block library facilitates the implementation of your safety functions in the Interbus Safety system considerably. Safety functions can be planned and programmed quickly and safely with the help of the standardized and certified modules. Validation of your application becomes faster as separate modules do not need to be created. The function blocks provide diagnostics information such as the condition of the connected protective equipment, error messages, acknowledgement signals or active startup inhibits in plain text automatically via the Diag+ diagnostic tool. The condition of the safe application is thus presented clearly.

Optimum support for the user

All function modules implement the required startup inhibits as an option. You only need to parameterize and connect the function modules in order to program the startup inhibits required in your application. It couldn't be simpler or faster!

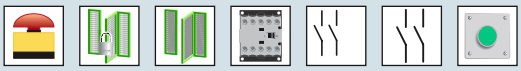

Diag+ 2.1
Communication Path
Disconnect
View
INTERBUS Diagnostic
Bus Architecture
Bus Info
Optical Diagnostic
Statistic
Settings
Solution
Device Diagnostic
Function Block Diagnostics
History
SF_EmergencyStop_V1_00
Main.E_STOP_V1_00_1.DiagCode
SF_EnableSwitch_V1_00
SF_MutingSeq_V1_00
SF_MutingPar_V1_00
SF_TwoHandControlTypeII_V1_00
The startup inhibit to be implemented following activation of the function block is not specified
(S_StartReset = TRUE) and the function block has been activated or the enable output has been
deactivated via the state of the emergency stop signal.
The emergency stop control device is active and locked or the wiring is faulty, or the safe device
connected to the emergency stop
Release the activated and locked
If the emergency stop control devi
emergency stop control device.
Diagnostics Code: 8004hex
Project Na
RUN
After releasing the emergency stop control device the function block detected a static TRUE signal at
Reset.
Check the control device that controls the Reset formal parameter and the corresponding wiring.
Diagnostics Code: C002hex
Project
RUN
The emergency stop control device is released again. The function block startup inhibit is active.
Execute a reset at the function block.
Diagnostics Code: 8005hex
Project Name:
RUN

OSSD

Order No. 2916859

The library provides modules for safety functions with electrosensitive safety equipment right from the signal evaluation to the test of the protective equipment including all the required startup inhibits.

- SF_Espe (evaluation of electrosensitive safety equipment)
- SF_TestableSafetySensor (test module for electrosensitive safety equipment of type II)



Basic_SF

Order No. 2876067

The library supports you with basic safety functions including all the required startup inhibits. Apart from the emergency stop button and the safety door monitoring with and without guard locking, the control of safe actuators and their feedback circuit monitoring is also covered. Furthermore, you can also carry out equivalence and antivalence evaluations of various signal sources.

- SF_EmergencyStop (emergency stop monitoring)
- SF_GuardMonitoring (protective door monitoring without guard locking)
- SF_GuardLocking (protective door monitoring with guard locking)
- SF_EDM (external device monitoring/ feedback monitoring)
- SF_OutControl (control of a safe output in connection with an standard input including all required startup inhibits)
- SF_Equivalent (checking the equivalence of two signals)
- SF_Antivalent (checking the antivalence of two signals)

Presentation of the Basic_SF library in the safe programming software SafetyProg

TwoHand

Order No. 2916846

The library contains safety functions for two-hand circuits of type II and type III including all necessary startup inhibits. The function modules evaluate the signals of the connected two-hand operating devices as per the specified typification. The output signals are formed on the basis of the signal evaluation.

- SF_TwoHandControlTypII (two-hand circuit of type II)
- SF_TwoHandControlTypIII (two-hand circuit of type III)

Muting

Order No. 2916862

The library supports you in muting applications with up to two to four muting sensors for parallel and sequential muting including all necessary startup inhibits. The function modules evaluate the signals of the muting sensors and the electrosensitive protective equipment. The output signals are formed on the basis of the defined muting sequences in connection with the signal evaluation.

- SF_MutingPar_2Sensor (muting module for parallel muting of two sensors)
- SF_MutingSeq (muting module for serial muting of four sensors)
- SF_MutingPar (muting module for parallel muting of four sensors)

SafeMode

Order No. 2916875

The library supports you during the implementation of safe functions such as the selection of safe operating modes, the feedback of the safe operating mode of safe drive regulators by means of I/O coupling or the enable switch monitoring for execution of the selected safe operating mode (e.g. safe reduced speed).

- SF_ModeSelector (execution of an operating mode selection switch)
- SF-SafetyRequest (request for a safe operating mode for a safe drive regulator)
- SF_EnableSwitch (evaluation of signals of an enable switch)

Services in safety engineering

Following the motto "Simplicity in safety", we have – in addition to our safety product portfolio – developed a perfect service concept that covers the entire life cycle of your machine or system. We support you right from the first consultancy appointment on through concept planning, installation, commissioning and operation, and system modernization. You can decide whether you want to make use of the know-how of a Phoenix Contact engineering or service expert or whether you want to qualify your employees accordingly.

In addition to the components used, safety also depends on the employees involved. Our free safety evening seminars are a good opportunity for you to get acquainted with the subject. The standard training program is structured such that it perfectly qualifies everybody involved with the safety engineering. Company-specific requirements are covered through individual training programs and workshops.

Our safety expert team develops and supports a concept individually adapted to your requirements on the basis of the machinery directive and other specifications. Benefit from our comprehensive competence and years of experience.

Safety Engineering

Order No. 2692089

Statutory regulations must be adhered to even before putting a machine on the market. Contact us now for more information! Our engineering experts are with you right from initial planning up to startup and will support you during system modernization. We work in close cooperation with your employees to implement the safety concept best suited to your application.

- Development of the safety concept
- Planning & project planning
- Support for risk analysis
- Support in the case of specific programming requirements
- Generation of function modules
- Retrofit

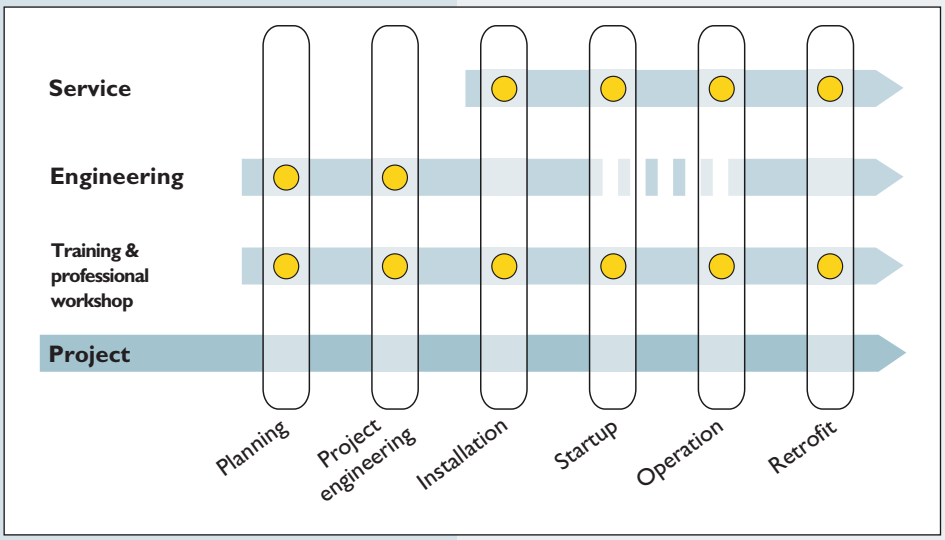
Safety Service

Order No. 2851202

We are at your side with our extensive range of services during the operation of your application. We answer general questions about the functionalities of individual components or assist you during the operating process. Furthermore, you can also consult our safety experts regarding extending machines and systems.

- Consultation
- Startup support
- Safety telephone support
- Specialist hotline
- Local servicing

In addition to the standard services in the individual project phases, we also provide you with services in safety engineering over the entire life cycle of your machine and system.



24h-Safety-Hotline

+49/5281-946-2777

safety-service@phoenixcontact.com

Our training offer at a glance

Safety Technology Basics

Order No. 2850821

The training program informs you about the meaning of safety engineering in mechanical and plant engineering. The principles, components, and solutions of safety-related control system technology will be covered. Apart from the structure of standards and the safety categories, the machinery directive and other relevant concepts will be explained.

Target group
Planners, project planners, service and maintenance personnel, startup engineers, electricians, decision-makers

Requirements
Basic knowledge of electrical and industrial automation engineering

Program
- Examples of safety engineering in mechanical and plant engineering
- Terms and definitions (cat., SIL, PL)
- Standard situation and guidelines
- Safety functions
- New machinery directive 2006/42/EU
- Basic requirements according to EN 60204-1, IEC 61508, EN 954-1, EN ISO 13849-1 and EN IEC 62061
- Responsibilities and law-abiding actions

Duration: 1 day

New Safety Standards

Order No. 2692335

The workshop explains the legal and normative basics for the required machine safety. You are provided with an overview of the standards, their context as well as the differences in the requirements regarding the functional safety of the machine. The new standards EN ISO 13849-1 and EN IEC 62061 are explained in detail using a practical example.

Target group
Designers, system integrators and applications engineers in mechanical engineering

Requirements
Basic knowledge of electrical and industrial automation engineering

Program
- Risk analysis for the safety on the machine
- Safety categories and deterministic error determination as per EN 954-1 (ISO 13849-1:1999)
- Area of application, requirements and proof of safety as per EN IEC 62061:2005
- Area of application, requirements and proof of safety as per EN ISO 13849-1:2006
- Which standards must or can be used?
- What do the new standards mean for the manufacturers of safety components as well the user/mechanical engineer?
- Required specifications for safety-related reliability

Duration: 1 day

Follow-up Safety Standards

Order No. 2792364

You will apply the knowledge you have acquired about the new standards in the New Safety Standards workshop in practical applications. Using the example of a production machine, you will be guided through the process of designing safety-related parts of machines and system controllers. This process includes identifying and determining the protective measures, determining the required capacity, as well as the structure and the measures for validation and verification.

Target group
Designers, system integrators and applications engineers in mechanical engineering

Requirements
Basic knowledge of safety engineering and participation in the New Safety Standards training workshop

Program
- Analysis of danger areas in a machine
- Definition of the requirements for safety functions
- Determining the required performance (PLr or SIL)
- Designing the control system architecture taking into account the relevant parameters (e.g. $MTTF_d$, DC, PFH_D, SFF)
- Determining the performance achieved (PL or SIL)
- Verification and validation

Duration: 1 day

Interbus Safety System Course

Order No. 2884651

You will become familiar with the function and structure of the Interbus Safety system and will get to know the installation and connection technologies of the safe signal generators. The required safety category will be implemented during the project planning of the system with one or two channels accordingly. In addition, a startup will be carried out using the Config+ and PC Worx software tools.

Target group
Planners, project planners, startup engineers, service and maintenance personnel

Requirements
Basic PC knowledge as well as general knowledge of electrical, automation and safety engineering

Program
- Interbus Safety basics
- Calculation of response and switch-off times
- Topologies, function, option for one or two-cable solution
- Components, connection technology, basic specifications, documentation
- SIL directive in accordance with EN IEC 62061
- Generation of an Interbus configuration
- Installation and connection technology
- Addressing options, data exchange between standard and safe control systems
- Diagnostics using the Diag+ software

Duration: 2 days

SafetyProg User Course

Order No. 2884680

The training program teaches you how to handle the safe SafetyProg programming software. How to adopt and configure safe modules is dealt with, as is the communication between the safe and the standard control system. You will parameterize the safe bus devices in accordance with the safety requirements. You will get acquainted with the software programming options and the functioning of the safe function modules.

Target group
Planners, project planners, programmers

Requirements
Basic PC knowledge as well as general knowledge of electrical, automation and safety engineering

Program
- User management, rights, documentation, project information
- Safety-relevant parameters
- Acceptance of bus configuration, addressing, communication
- Parameterization of safe modules
- Integration of safe PLCopen function modules
- Program structure, programming guidelines, global and local variables
- Generation of a safe program
- Diagnostics and history evaluation

Duration: 2 days

Training & Profi Workshop

Order No. 2710194

Your employees will be qualified directly on the application within the scope on the job training or a professional workshop. Our service engineers will explain the programming, bus and system diagnostics functions, and the integration of bus and control system technology.

Target group
Programmers, startup engineers

Duration: 1 to 3 days

The current prices and schedules of the training programs can be found in our Online catalog

www.eshop.phoenixcontact.com
under

AUTOMATION
↳ AUTOMATIONWORX
↳ Services
↳ Safety engineering

Standards for functional safety

The EU machinery directive 98/37/EU is binding as a regulation for machine manufacturers. In particular, the directive specifies the prerequisites that must be met before a new machine can be placed on the EU market. The directive contains important essential health and safety requirements for the protection of the users. These must be taken into account during the development and design of a machine.

CE marking

Ready-to-use machines and systems must have CE marking before they can be placed on the market and operated. Based on article 95 of the EU agreement, the manufacturer uses the CE marking to declare that all the relevant guidelines and specifications of the European Union (EU) regarding free goods traffic have been adhered to.

An excerpt from the 98/37/EU machinery directive

Type A standards
Basic safety standards

EN 12100 – Safety of machines - Basic concepts, general principles for design

EN 1050 – Safety of machines - Risk assessment, part 1 Principles

Type B standards
Safety group standards

EN ISO 13849-1 – Safety parts of control systems, part 1 General principles for design
Harmonized since May 2007
Supplements EN 954-1: 1996 with quality management and reliability aspects
Performance Level PL a to e

EN IEC 62061 – Functional safety of safe electrical, electronic and programmable electronic control systems
Harmonized since January 2006
Sector standard for the field of application of mechanical engineering using the life cycle model
Safety integrity level SIL 1, 2 and 3

EN 60204-1 – Electrical equipment of machines

Type C standards
Product safety standards

Machine safety standards giving detailed safety requirements on all significant dangers for a particular machine or group of machines, e.g. injection molding machines.

The basic health and safety requirements specified in the machinery directive 98/37/EU and other internal market guidelines are enforced using European standards, wherein a differentiation is made between basic standards (type A), group standards (type B) and product standards (type C).

Area of application of the new safety standards

So far, the EN 954-1 had to be used as a proof for the fulfillment of the essential health and safety requirements specified in the machinery directive. Since today not only electronics, but in particular programmable electronics have established themselves in safety engineering, safety can no longer be measured using the simple category system of EN 954-1.

Due to the deterministic concept of the standard in which all variables are clearly laid down, no more statements about the probability of a failure can be made. As the successor standards of EN 954-1, the new EN ISO 13849-1 and the harmonized EN IEC 62061 standards provide a probalistic approach that works with statistical probabilities.

Why does a supposedly identical field of application have two different standards?

EN ISO 13849-1	EN IEC 62061
Comes from EN 954-1:1996 and is supplemented with quality management and reliability aspects	Sector standard for the field of machines that was created on the basis of IEC 61508
Best suited for less complex systems	Can only be used for highly complex electronic technology and here particularly for complex programmable systems
Can also be used for other technologies apart from electronics, e.g. pneumatic or hydraulic system	Procedure for proof of safety of electronic technology based on IEC 61508
Suitable for proof of safety of devices as well as for evaluation of risk reduction of the entire safety function via tables	Suitable for proof of safety of devices as well as for evaluation of risk reduction of the entire safety function through calculation

From categories to probabilities

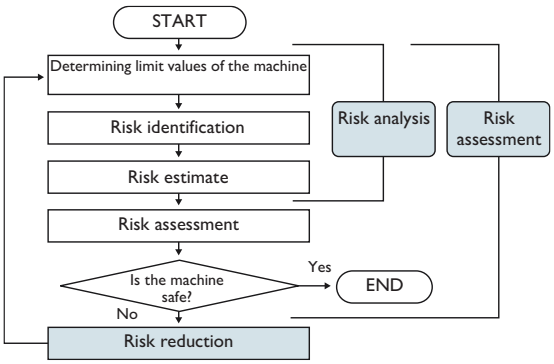
Performance Level (PL) EN ISO 13849-1	Mean probability of one dangerous failure per hour	SIL as per IEC 61508 and EN IEC 62061	Max. acceptable safety system failure
a	$\geq 10^{-5}$ to $< 10^{-4}$	–	One risk failure every 10000 hours
b	$\geq 3x10^{-6}$ to $< 10^{-5}$	1	One risk failure every 1250 days
c	$\geq 10^{-6}$ to $< 3x10^{-6}$	1	One risk failure every 115.74 years
d	$\geq 10^{-7}$ to $< 10^{-6}$	2	One risk failure every 115.74 years
e	$\geq 10^{-8}$ to $< 10^{-7}$	3	One risk failure every 1,157.41 years

Unlike the deterministic concept of EN 954-1, the EN ISO 13849-1 and the EN IEC 62061 are based on a probabilistic concept that takes into account the probability of those errors occurring that lead to a safety function failure and categorizes them as PL or SIL (high demand).

EN ISO 13849-1: 2006

Safety-related parts of control systems (SRP/CS)

Risk assessment and reduction



In order to identify dangers and implement preventive measures, EN ISO 12100-1 recommends an iterative process:

1. Determining the physical and time-related limits of a machine
2. Identifying dangers and estimating risks
3. Estimating the risk for each identified danger
4. Risk assessment

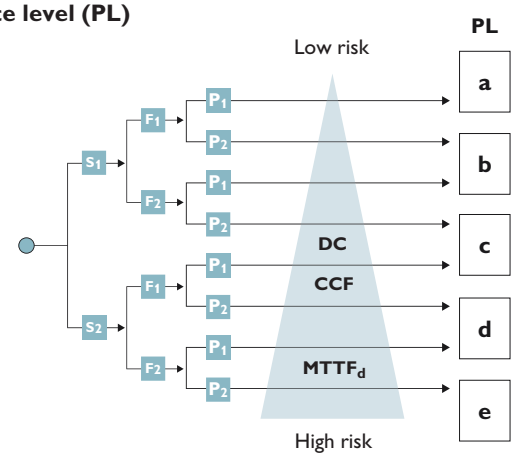
Risk assessment and structure of the safety function

a) Determining the required performance level (PL)

S = Severity of injury
S_1 = Mild, reversible injury
S_2 = Severe, irreversible injury to one or more persons or death

F = Frequency and/or duration of the danger
F_1 = Seldom to frequent, short duration
F_2 = Frequent to permanent, long duration

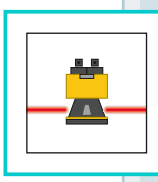
P = Possibilities for avoiding the danger
P_1 = Possible under certain conditions
P_2 = Hardly possible



b) Design of the control system architecture and determining the capacity attained

The PL of SRP/CS is determined by estimating the following parameters:
- Category (given as a defined structure)
- MTTFd (mean duration up to a dangerous failure)
- Diagnostic coverage degree (DC) from a table
- CCF (failure following a common cause) as a point system according to various criteria

The attained PL is recorded using a table and must be equal to or greater than the required PL.



$$PL \leq PL_r$$

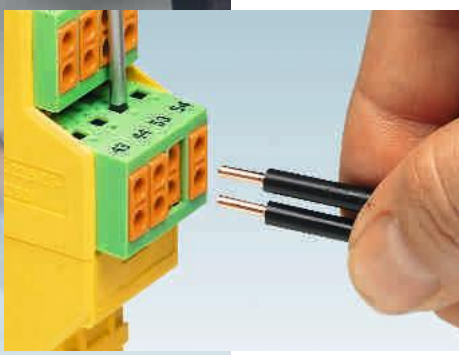
Validation

The implementation of safety-related control system functions must be checked. Validation proves that the safety function

Wide range of safety relays in a narrow housing

Our PSR safety relays have proven that innovative safety solutions do not necessarily need to be complex in order to be able to fulfill the high safety requirements of mechanical and plant engineering. In addition to easy integration and handling, our modules are characterized in particular by their compact, space-saving design as well as their excellent quality and maximum safety and reliability. Other advantages of the safety relays are:

- Innovative connection technology
- Modular expandability
- Universal applicability on the basis of all relevant approvals



Convenient connection technology

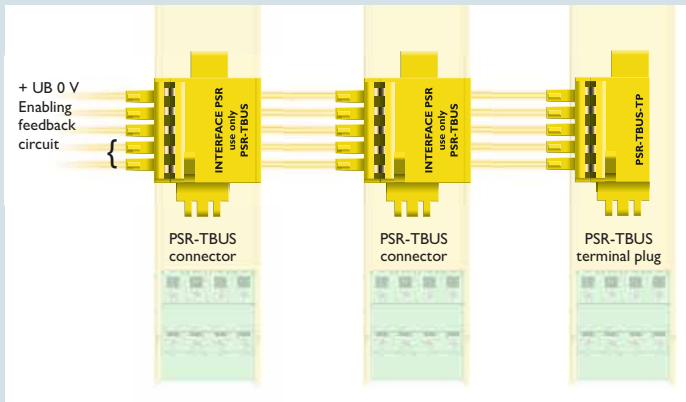
All PSR safety relays are available with pluggable screw or spring-cage connection technology. Here, the Twin spring-cage connectors provide space for two lines per connection point.

Quick expandability

The PSR TBUS DIN rail connector is used for the modular expansion of the PSR safety system with additional switching contacts. Wiring costs are minimized due to the "internal" pre-wiring.

The modular PSR safety relay system with PSR-TBUS connection

Our PSR safety relay system reduces the space requirement in the control cabinet, simplifies wiring and minimizes storage costs. The multifunctional PSR-SDC4 master relay is able to monitor signals from different types of safety sensors and switches. The PSR-SDC4, that can also be used as a standalone safety relay, is simple to setup and requires no programming or setting of dip switches. Safety relays can be easily connected to the PSR-SDC4 via PSR-TBUS connectors for input or contact extension. The PSR-TBUS forms an integral backbone for the control and feedback signals to and from the extension units and significantly reduces the wiring typically associated with safety relays.



The safety-related wiring between the individual PSR modules is enabled automatically via the PSR-TBUS DIN rail connector. Besides the supply voltage, an enable signal and the feedback path of the extension modules are led over the connector. The terminal plug closes the feedback circuit in the system.

The contact extension modules are automatically connected to the master safety relay via PSR-TBUS DIN rail connectors. The modules are quickly installed onto the connectors via a simple swivel action.

EN IEC 62061: 2005

Functional safety of safety-related electrical, electronic and programmable electronic control systems (CE/E/PES)

The way to a safe machine or system

A reduction in the risk posed by the danger is carried out in three steps:

1 Constructive measures → **2** Technical protective measures → **3** User information

Detailed information can be found in the EN 1050 standard and in future, in the EN ISO 14121 standard

a) Determining the required capacity

Effects	Severe **S**	Class 3 – 4	Class 5 – 7	Class 8 - 10	Class 11 - 13	Class 14 - 15
Death, loss of an eye or arm	4	SIL 2	SIL 2	SIL 2	SIL 3	SIL 3
Permanent, loss of fingers	3			SIL 1	SIL 2	SIL 3
Reversible, medical treatment	2	Other measures			SIL 1	SIL 2
Reversible, first aid	1					SIL 1

Determination of the necessary SIL

F Frequency and duration	
≤ 1 hour	5
> 1 hour to ≤ 1 day	5
> 1 day to ≤ 2 weeks	4
> 2 weeks to ≤ 1 year	3
> 1 year	2

+

W Probability of a dangerous incident	
Frequent	5
Probable	4
Possible	3
Seldom	2
Negligible	1

+

P Avoidance	
Impossible	5
Possible	3
Probable	1

The standards are presented in an extremely simple manner for better understanding.

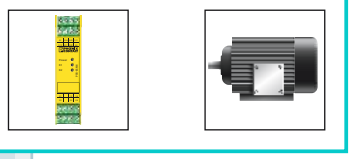
b) Design of the control system architecture and determining the capacity attained

The safety-related parameter for part systems comes from the following values specified by the manufacturer for certified devices:

- SIL CL (SIL demand limit; SIL Claim Limit)
- PFH_D (probability of dangerous failures)
- T1 (duration of use)

The part systems can consist of differently connected devices for which the following parameters must be specified, in order to be able to record the appropriate PFH_D value of the part system:

- $\sum \lambda$ (Lambda, failure rate)
- SFF (Safe Failure Fraction)



Architecture of the safety function (SRP/CS, SRECS)

fulfills the appropriate requirement. Tests, for example, are conducted and documented for this purpose.

Safety-related parameters

EN ISO 13849-1

The following safety-related parameters must be recorded in accordance with **EN ISO 13849-1** within the scope of proof of safety:

Abbreviation		Explanation
PL	Performance Level	Discrete level that specifies the capacity of the safety-related parts of a control system to execute a safety function under foreseeable conditions; Classification from PL a (maximum probability of failure) to PL e (minimum probability of failure)
$MTTF_d$	Mean Time to Failure dangerous	Mean duration till a dangerous failure takes place, which can be recorded with the help of an analysis of the field data or by means of a prediction
B_{10d}		Number of switching cycles during which 10% failed during a random test of the observed worn components (e.g. electromechanical components)
T_M	Mission Time	Planned duration of use
DC	Diagnostic Coverage	Diagnostics coverage degree, i.e. decrease of probability of dangerous failures taking place due to the implementation of automatic diagnostics tests

EN IEC 62061

The following safety-related parameters must be recorded in accordance with **EN IEC 62061** within the scope of proof of safety:

Abbreviation		Explanation
SIL	Safety Integrity Level	Discrete level that defines the requirements for safety integrity of the safety-related control system functions of the electrical control system of the machine; classification from SIL 3 (highest level) to SIL 1 (lowest level)
PFH_D	Probability of a dangerous failure per hour	Probability of a dangerous failure per hour
T1	Lifetime or Proof Test Interval	Time interval during which the protective equipment must be manually tested
λ_D	Lambda	Rate of dangerous failures
SFF	Safe Failure Fraction	Fraction of safe failures of the total failure rate that does not lead to a dangerous failure
HFT	Hardware Fault Tolerance	Fault tolerance of the hardware
DC	Diagnostic Coverage	Diagnostics coverage degree, i.e. decrease of probability of dangerous failures taking place due to the implementation of automatic diagnostics tests
MTTR	Mean Time to Repair	Mean time until when the system is repaired after a failure
β	Beta	Failure factor having a common cause

When and which standard should be used:

The following table provides an initial overview regarding which standards should be used for which type of product or system.

Technology	EN 954-1	EN ISO 13849-1	EN IEC 62061 (IEC 61508)
Non-electrical (e.g. hydraulic)	✓	✓	–
Electromechanical (e.g. relay), no complex electronics	✓	up to PL_e*	up to SIL 3**
Complex electronics (e.g. programmable)	–	up to PL_d*	up to SIL 3**
Mixed systems: non-electrical and electromechanical	✓	up to PL_e*	✓
Mixed systems: electromechanical and complex electronics	–	up to PL_d*	up to SIL 3**
Mixed systems: a) Non-electrical and complex electronics or b) Non-electrical/electromechanical and complex electronics	–	✓	✓

* *Only designated architectures*
** *all architectures*

EN 61508
Functional safety of safety-related electrical/ electronic/programmable electronic systems

IEC 50156 Combustion plants	**IEC 60601** Medical engineering
IEC 61513 Nuclear power	**IEC 61511** Process technology
IEC 50128 Railway applications	**IEC 61800-5-2** Electrical drives

As a generic standard, IEC 61508 supports safety-related products that are used in the area of application of sector standards such as IEC 61511, EN 50156 or EN IEC 62061 during their development.

Why should you opt for a safety solution from Phoenix Contact?

- Our products and systems are continuously developed in accordance with the latest standard status and certified by TÜV and the Professional Institute for Safety at Work (BGIA)
- All internal processes are adapted to the requirements of the relevant standards. Measures for preventing errors are implemented right from development and manufacturing of the devices as well as during their operation
- Our solutions are characterized by simple handling over the entire life cycle and are approved up to SIL 3 in accordance with EN IEC 62061 and PL e as per EN ISO 13849-1. They thus fulfill the highest requirements regarding safety engineering and can be used in all safety-related applications
- In addition to a complete product portfolio, we also provide you with a comprehensive service offer including not only programming and commissioning support and detailed consultancy services, but also a wide range of training courses. Free evening seminars in which complex contents are structured in a comprehensive manner as well as a 24-hour hotline (+49/5281-946-2777) complete our range of services.

TÜV Rheinland Group Functional Safety FS Type Approved

BGIA

Further information on the products presented here and on the world of solutions from Phoenix Contact can be found at
www.phoenixcontact.com

Or contact us directly.

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Marking Systems and Mounting Material
CLIPLINE

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PLUSCON

PCB Connection Technology
and Electronic Housings
COMBICON

Surge Protection
TRABTECH

Signal Converters, Switching Devices,
Power Supply Units
INTERFACE

Components and Systems
AUTOMATION

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